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STANDARDS DEVELOPMENT BRANCH OMOE
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SURVEY REPORT

AIR QUALITY SURVEY (TAGA)
DOMTAR, TRENTON
MAY, 1987

ARB-146-87

FEBRUARY 1988

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1988
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Ministry
of the
Environment

Ontario

E. PICHÉ, Director
Air Resources Branch

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Survey Report

Air Quality Survey (TAGA)
Domtar, Trenton
May, 1987

ARB-146-87

-prepared for-

The Southeastern Region
Ontario Ministry of the Environment

-prepared by-

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Executive Summary

During the weeks of May 18 and 25, 1987, the mobile TAGA (3000) unit of the Air Resources Branch performed an air quality survey in Trenton, at the request of the Southeastern Region of the Ontario Ministry of the Environment. The survey objective was to chemically `fingerprint' the odours associated with Domtar's Wood Preserving Plant and Paper Mill including the waste black liquor lagoon.

The monitoring results indicate that the Domtar Wood Preserving Plant was a source of several odourous compounds, albeit in areas of close proximity to the plant. The compounds, which were tentatively identified, can be classified as phenols, aromatic amines, and PAHs. Estimated concentrations for a 2-minute average were typically 1 to 35 ug/m^3 in residential areas directly downwind of the Wood Preserving Plant. The most abundant contaminants detected were phenol, and naphthalene. With the exception of naphthalene, the detection of PAHs was generally confined to the plant property. It may be of interest to note that, of the contaminants detected in the residential areas, only the naphthalene levels (up to 35 ug/m^3) approached the Ministry guideline of 36 ug/m^3 for a 1/2-hour averaged concentration. Recall, however, that the levels quoted are estimates and represent 2-minute averaged concentrations.

Mobile air monitoring was also conducted right beside the black liquor lagoon of Domtar's Paper Mill. Trace levels (approximately 1 to 25 ug/m^3) of aliphatic alcohols, phenols, aromatic amines, and naphthalenes were recorded at monitoring locations a few metres from the lagoon edge. The survey crew did not detect the lagoon odours (or compounds) off plant property, in neighbouring residential areas.

Sommaire

Pendant les semaines du 18 et du 25 mai 1987, l'unité mobile d'analyse des gaz atmosphériques à l'état de trace (modèle 3000) a effectué des contrôles atmosphériques à Trenton, à la demande de la Région du Sud-Est du ministère de l'Environnement de l'Ontario. L'enquête avait pour objet de faire la caractérisation chimique des odeurs provenant de l'usine de préservation du bois et de la papeterie de Domtar, notamment de l'étang d'eaux noires résiduaires.

D'après les résultats, l'usine de préservation du bois serait à l'origine de plusieurs composés odorants, mais dans les environs immédiats seulement. Les composés, qu'on a tenté d'identifier, pourraient être des phénols, des amines aromatiques et des HPA. En général, les concentrations moyennes sur deux minutes varieraient entre 1 et 35 ug/m^3 dans les zones résidentielles situées directement sous le vent par rapport à l'usine. Les polluants les plus abondants seraient les phénols et le naphtalène. Hormis cette dernière substance, des HPA n'ont généralement été détectés que sur les terrains de l'usine. Il est intéressant de noter que de tous les polluants détectés en zone résidentielle, seul le naphtalène avait une concentration (jusqu'à 35 ug/m^3) approchant la limite moyenne recommandée par le ministère sur une demi-heure, à savoir 36 ug/m^3. Rappelons cependant qu'il s'agit de concentrations estimées à partir des concentrations moyennes sur deux minutes.

On a aussi effectué la surveillance atmosphérique aux abords de l'étang d'eaux noires de la papeterie de Domtar. À quelques mètres des bords de l'étang, on a détecté des substances à l'état de trace (environ de 1 à 25 ug/m^3), soit des alcools aliphatiques, des phénols, des amines aromatiques et des naphtalènes. On n'a détecté aucune odeur ni aucun composé provenant de cet étang hors du terrain de l'usine dans les zones résidentielles avoisinantes.

Table of Contents

Page No.

Executive Summary 1

1.0 Introduction 3

2.0 The TAGA `Fingerprinting' Technique 4
  2.1 Survey Strategy 4

3.0 Results and Discussion 5
  May 19 6
  May 20 6
  May 21 7
  May 22 7
  May 25 8
  May 26 8

4.0 Summary and Conclusions 8

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1.0 Introduction

At the request of the Southeastern Region of the Ontario Ministry of the Environment, the Air Resources Branch conducted a mobile air monitoring survey in the vicinity of Domtar in Trenton, Ontario. The Southeastern Region expressed a special interest in Domtar's Wood Preserving Plant and the waste black liquor lagoons of the Paper Mill. Thus the survey objective was to chemically `fingerprint' any odours emanating from these two sources of interest. The mobile TAGA 3000 unit, which has conducted several odour surveys throughout the province, was assigned to this study. The TAGA, or Trace Atmospheric Gas Analyzer, possesses the unique capability of real-time monitoring of a broad range of atmospheric contaminants at trace (ppb) levels.

Domtar Wood Preserving treats railway ties and utility poles at a 50 acre site in Trenton. The plant uses two types of wood preservatives: a 50/50 mixture of heavy oil and creosote to treat railway ties; and a 95/5 mixture of heavy oil and pentachlorophenol (PCP) for preserving utility poles. The treating process involves impregnating the wood with the appropriate oil mixture for several hours under pressure in a large cylinder vessel. Afterwards, the wood is removed and air dried on-site in an open area. The emission of odourous compounds would occur during the open air drying stage, especially when the wood is fresh from the retort.

Immediately north of the Wood Preserving Plant is Domtar's Paper Mill, which manufactures a grade of paper for corrugating medium. The main area of interest regarding odours at the mill is the lagoons used to treat the waste black liquor.

During the survey period, Domtar was not utilizing any PCP solutions. Infact, Domtar had not used PCP oil two months previous to the survey period, and its use was not anticipated in the near future. Nevertheless, air samples acquired at the wood preserving facility were specifically checked for the presence of fugitive PCP, as well as other contaminants detectable by the TAGA technique.

Presented here is the analysis of air samples acquired downwind of Domtar as determined in the field by the mobile TAGA unit during May 1987.

2.0 The TAGA `Fingerprinting' Technique

The Trace Atmospheric Gas Analyser (TAGA) model 3000 is a specialized quadrupole mass spectrometer (MS) with an unique air sampling inlet system and ion source (See Figure 1). Ambient air is sampled directly at a high flow rate (100 l/min.) into the ion source operating at atmospheric pressure. Ionization of trace contaminants is achieved by chemical ionization (CI) initiated by a corona discharge. Selective ionization of chemical classes is accomplished through the addition of the appropriate CI reagent to the flowing air sample: for example, water to highlight ketones, aldehydes, alcohols and acids; oxygen to highlight phenols, chlorophenols, and acids; benzene to highlight aromatics and sulfurous species; and ammonia to highlight amines, amides and some ethers.

The ionization of pollutants yields a mixture of pseudo-molecular ions which are immediately subjected to mass analysis up to 250 amu (atomic mass units). Mass `fingerprinting' is achieved in approximately 20 minutes if all four CI reagents are employed. The chemical or pollutant fingerprint arises from the interpretation of all of the mass spectra for a given monitoring period. Since the analysis of TAGA (3000) data is based on mass spectral interpretation, the resultant chemical identities are somewhat tentative, the degree of which depends on the sample composition.

Owing to the system's unique features of direct air sampling, and atmospheric pressure chemical ionization, the technique is highly sensitive to many polar organic pollutants in the real-time. In general, the TAGA can detect volatile compounds which contain a heteroatom, such as N, O, P, S, or halide. The real-time limits of detection for the TAGA range from 0.1 to 10 ug/m^3 depending on the type of chemical(s) and the complexity of the sample matrix.

2.1 Survey Strategy

The basic survey strategy was to position the TAGA downwind of the source of interest during an odour episode and quickly acquire mass spectra while changing the CI reagents. Ideally, odours must be present for at least 20 minutes, the time it takes to complete fingerprinting procedures. In addition to downwind (source) monitoring, the fingerprint mass scans are acquired at locations upwind of the suspected source (background). The source data is then background corrected by simply subtracting the upwind response from the downwind response for each amu. The net signal is attributed to the source provided the wind direction is appropriate.

The selection of monitoring sites is based upon several observations:

1) wind direction/wind speed
2) plume tracking (real-time target compound measurements while mobile)
3) odour characteristics
4) type of chemicals detected (fingerprint)
5) accessibility and roads network

The mobile TAGA unit is equipped with a meteorological station which allows monitoring of wind speeds and wind directions at a height of 10 metres.

Since the purpose of this study was to identify the odourous components detectable by TAGA, accurate quantitation of the observed pollutants was not attempted at this time. However, `best' estimates of pollutant concentrations are provided as a basis for target pollutant selection should additional monitoring be requested.

3.0 Results and Discussion

The mobile TAGA unit conducted ambient air monitoring in Trenton on May 19, 20, 21, 22, 25, and 26, 1987. A total of 16 `fingerprints' of the ambient air were determined at ten locations downwind of Domtar. Monitoring was conducted on Domtar property close to the sources of interest, as well as in residential areas on both sides of the Trent River (see Map 1). The survey activities are summarized in Table 1, which includes information regarding monitoring periods, sampling locations, local meteorological conditions and relevant comments.

The survey findings are summarized according to Domtar's two neighbouring plants: the Wood Preserving Plant (Table 2); and the Paper Mill, including the lagoon (Table 3). When reviewing the data contained in Tables 2 and 3, consider the following:

1) compound identities are tentative since they are based on mass spectral interpretations;
2) concentrations quoted are only estimates (within a factor of 3) since on-site calibrations were not required for fingerprinting purposes;
3) full mass scans (10 to 250 amu) using four CI reagents were acquired for all monitoring periods;
4) all data were background (upwind) corrected;
5) the TAGA (3000) is not sensitive to all atmospheric constituents-most notably the aliphatic hydrocarbons;
6) the TAGA technique registers gas phase components of air - not particulates or aerosols.

The selection of monitoring sites was based upon the criteria described under Survey Strategy. Mr. Bob Michea of the Ministry's Southeastern Region provided assistance to the mobile TAGA scientists in the execution of the survey.

May 19

After establishing background levels upwind of Domtar, the mobile TAGA unit performed plume tracking along the west side of the Trent River. An increase in ambient concentrations of naphthalene was observed at Water Street and Frankford Road, approximately 1 kilometre northwest (downwind) of Domtar.

Shortly after 18:00 hours the TAGA was positioned downwind of Domtar at the bottom of Frankford Crescent, away from any vehicular traffic (Site A). Faint odours resembling the Wood Preserving Plant were noted from time to time. Mass spectral analysis of the ambient air (fingerprint 01, Table 2) revealed the presence of phenol, pyridine, picoline, naphthalene and methyl naphthalene in the estimated concentration range of 1 to 5 ug/m^3 for a 2-minute average.

May 20

Air monitoring was conducted on plant property (Site B) in order to obtain a representative fingerprint of Wood Preserving Plant odours. Just after 12:00 hours the mobile TAGA unit was located three metres away from several piles of railway ties that had been treated with creosote just hours previously. Strong odours were present at the time of sampling. The ambient air fingerprint (number 02, Table 2) contained 16 compounds. Included in this list are some phenols, aromatic amines and polyaromatic hydrocarbons (PAHs). The major components (tentatively) identified were phenol (est. 150 ug/m^3), naphthalene (est. 90 ug/m^3) and biphenyl (est. 75 ug/m^3). Note that these levels were recorded on plant property.

At 13:00 hours the TAGA was moved to Site C, ten metres north of the black liquor lagoon of the paper mill. Despite the monitoring location, the odours were considered weak. As shown in Table 3 (fingerprint 03) several compounds were detected above the background: methanol, ethanol, phenol, methyl phenol, naphthalene, methyl naphthalene, pyridine and picoline. The most abundant contaminants were phenol (est. 25 ug/m^3), naphthalene (est. 15 ug/m^3) and methanol (est. 10 ug/m^3).

Since the odours were rather faint, no further air monitoring was conducted near the lagoon. It is noteworthy that the black liquor odour was not discernable off plant property at any time during the survey.

Shortly after 14:00 hours the TAGA unit returned to the Wood Preserving Plant to monitor the air while freshly treated railway ties were being removed from the retort (Site D). The chemical fingerprints (numbers 04,05, Table 2) were very similar to those ascertained earlier in the day when the TAGA was located at Site B, which was also on plant property. Again, the air sampled a few metres downwind of the railway ties contained phenols, aromatic amines and PAHs. Also, the highest concentrations were again recorded for phenol (est. 100 ug/m^3) and naphthalene (est. 150 ug/m^3). During this monitoring period, creosote-type odours were obvious.

May 21

During the morning of May 21, the winds were out of the south. Consequently, the TAGA unit was situated on Marmora Street (Site E) to be downwind of Domtar's Wood Preserving Plant. Two fingerprints (numbers 06,07, Table 2) were taken of the ambient air during the occurence of light creosote-type odours. Trace levels (est. 1 to 35 ug/m^3) of phenol, pyridine, picoline, naphthalene, and biphenyl were the only compounds detected during the monitoring periods.

In the afternoon, following background monitoring, the TAGA was positioned at Mary Street and Marmora Street (Site F), downwind of the Wood Preserving Plant. The winds were out of the south southwest at 5 to 20 km/hr and the odours were generally light to nil. As indicated by the monitoring results obtained earlier in the day, low levels (est. 1 to 15 ug/m^3) of phenols, aromatic amines and naphthalene were evident in the fingerprints (numbers 08,09). Aside from naphthalene, no other PAHs were evident in the ambient air samples.

May 22

Having obtained several fingerprints of the odours originating from the Wood Preserving Plant, monitoring activities were shifted to the Paper Mill. At approximately 10:00 hours the TAGA was parked at the main entrance to Domtar's Paper Mill. Winds were light and variable out of the south. Occasionally the TAGA crew detected a black liquor odour mixed with a musty, woody odour. Despite the shifting winds, two fingerprints of the ambient air (numbers 10,11, Table 3) were taken. The only compounds evident in the full range mass scans of the ambient air were pyridine (est. 1 ug/m^3) and phenol (est. 10 ug/m^3).

After collecting background data, monitoring ceased for the day because the winds were too variable to isolate the desired source.

May 25

During the afternoon of May 25 the winds were easterly, and, the monitoring sites were selected on the west side of the Trent River, east of Water Street opposite the Paper Mill (Sites H and I). For brief periods faint odours were detected, so four fingerprints (numbers 12 to 15, Table 3) were determined between 12:30 and 17:30 hours. Aside from the periodic excusions in the ambient phenol level (est. 1 to 5 ug/m^3), the fingerprints were uneventful; that is , only phenol was detected.

May 26

On this day, light and variable easterly winds hampered the monitoring activities. Only one (1) fingerprint (number 16, Table 3) of the ambient air was taken, commencing at 14:52 hours. The monitoring location was at the end of Davis Street (Site J). During air sampling, an intermittent woody odour was detected, confirming that the monitoring site was downwind of the Paper Mill. Traces of methyl naphthalene (est. 3 ug/m^3), naphthalene (est. 1 ug/m^3), and picoline (est. 1 ug/m^3) were evident in the chemical fingerprint. No other compounds were detected by the TAGA.

4.0 Summary and Conclusions

The mobile TAGA unit conducted an air monitoring survey in Trenton, Ontario on May 19, 20, 21, 22, 25 and 26, 1987 at the request of the Ministry's Southeastern Region. The purpose of this survey was to atempt to fingerprint the odours associated with the Domtar Wood Preserving Plant and Domtar Paper Mill: that is, determine semi-quantitatively the contaminants downwind of the two aforementioned sources. The findings for this survey are summarized by the following points.

1) Creosote-type odours were recognizable downwind of Domtar Wood Preserving Plant. Generally the odours were strongest on the plant property and the public areas adjacent to Domtar. On occasion, however, faint odours were detected at distances approximately 1 kilometre from their source.

2) The black liquor lagoon odour was confined to an area next to the lagoon. The lagoon odours were not detectable off plant property.

3) Odours associated with the Domtar Paper Mill resembled a wet woody odour. Rarely was this odour discernible downwind of the plant west of the Trent River.

4) The monitoring results obtained with the mobile-TAGA unit indicated that freshly treated railway ties were a source of odours in the immediate area. Mass spectral analysis (fingerprint) of the odours indicated the presence of a small number of aromatic amines, phenols, and PAHs. In most cases the most abundant contaminants in air were phenol and naphthalene. It is estimated that the airbourne concentrations of the contaminants range from 1 to 150 ug/m^3 on plant property and 1 to 35 ug/m^3 off plant property next to the storage area. Note that, with the exception of naphthalene, the detectable levels of volatile PAHs were generally confined to sampling sites inside Domtar's yard. Also note that PCP was not detected in any of the air samples. This was expected, since PCP was not used by Domtar during this survey.

5) In regard to the Domtar Paper Mill, the monitoring results indicated low levels (est. 1 to 25 ug/m^3) of alcohols, both aromatic and aliphatic, naphthalenes and aromatic amines in the immediate location of the lagoon. Only traces (est. 1 to 10 ug/m^3) of phenols, naphthalene, pyridine and picoline were detected in the residential areas west of the Trent River. Like the odours, the presence of these compounds in ambient air samples was intermittent and barely detectable.

In conclusion, the survey results indicated that the main source of odours in the vicinity of Domtar was the Wood Preserving Plant. The results also indicated that during this survey the Domtar Paper Mill was not a significant source of odours in the area. It is suggested that the compounds partially responsible for the wood preserving odours were aromatic amines, phenols, and PAHs. It is important to note that the levels of these compounds were extremely low away from Domtar property. In fact, many of the compounds were not detected in ambient air samples acquired off plant property.

It may be of interest to note that of the contaminants detected in the residential areas, only naphthalene was present in levels comparable to existing Ministry Standards or Guidelines. The highest 2-minute averaged concentration of naphthalene was estimated at 35 ug/m^3, whereas the Ministry Guideline for naphthalene is 36 ug/m^3 for 1/2-hour average concentration. The Guideline for naphthalene is based on health effects.

TAGA 3000 SYSTEM

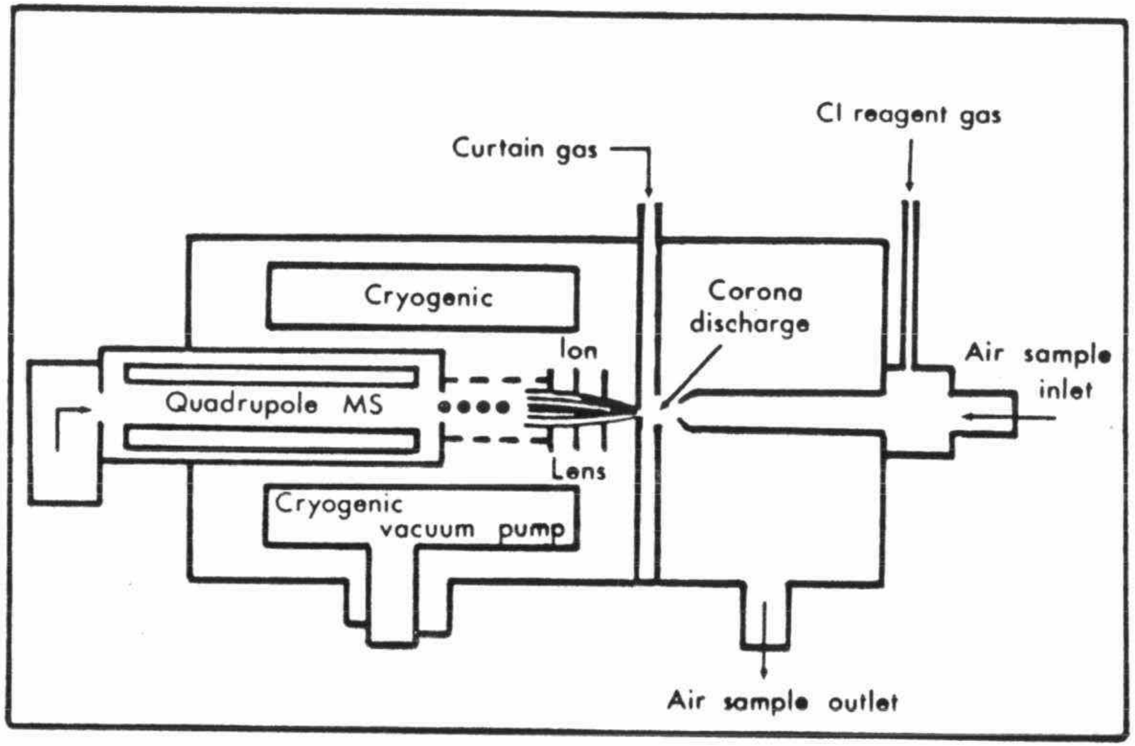
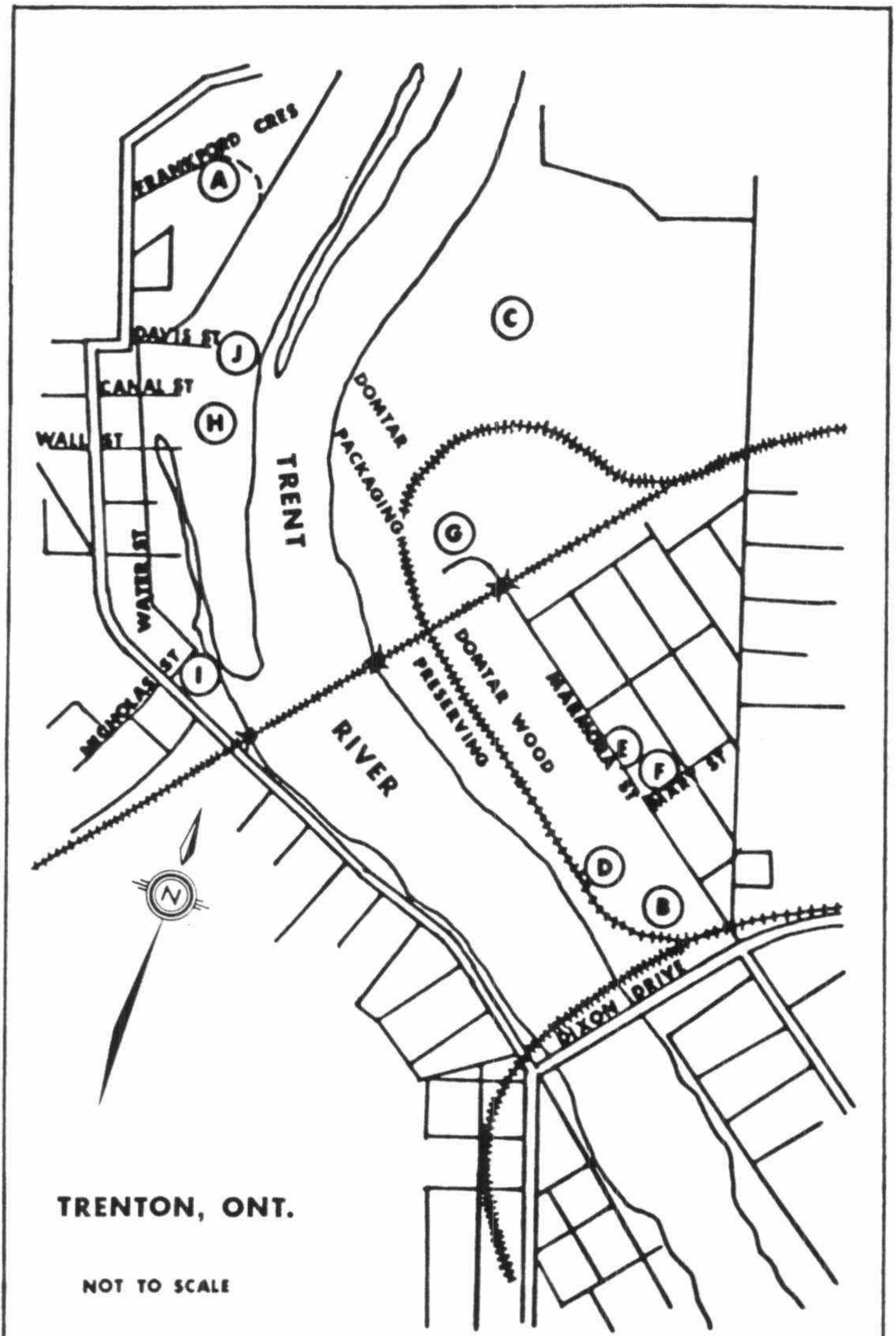


FIGURE 1: SCHEMATIC OF THE TAGA 3000 SYSTEM
INSTALLED IN MAMU #3



Map #1: Monitoring Sites for Mobile TAGA Unit
Domtar, Trenton Survey, May 1987

Table 1

TAGA Monitoring Periods and Locations

Trenton (Domtar) Survey 1987

Date	Fingerprint Number	Monitoring Period	Location[1]	Meteorological Conditions[2]			Probable Source	Comments
				AT	WS	WD		
May 19	01	18:16-18:36	A	16	10-20	SSE	Paper Mill Wood Treat.	Faint odour present.
May 20	02	12:29-12:45	B	n/a	n/a	n/a	Wood Treat.	Odour, On-site beside piles of freshly preserved wood.
May 20	03	13:32-14:30	C	13	15-30	SE	Paper Mill Lagoon	Black liquor odour;On-site next to west lagoon.
May 20	04	15:27-15:38	D	14	15-25	SSE	Wood Treat.	On-site as train being pulled from building.
May 20	05	15:42-15:55	D	14	15-25	SSE	Wood Treat.	On-site, train stopped next to TAGA.
May 21	06	10:25-11:11	E	14	05-15	S	Wood Treat.	Faint odour.
May 21	07	13:14-13:48	E	20	05-20	S	Wood Treat.	Faint odour.
May 21	08	14:16-14:37	F	20	10-15	SSW	Wood Treat.	Intermittent odour.
May 21	09	14:56-15:24	F	21	05-20	SSW	Wood Treat.	Intermittent odour.

(Table 1 continued...)

Table 1 (cont.)

TAGA Monitoring Periods and Locations

Trenton (Domtar) Survey 1987

Date	Fingerprint Number	Monitoring Period	Location[1]	Meteorological Conditions[2] AT	WS	WD	Probable Source	Comments
May 22	10	10:05-10:33	G	15	00-15	SSE	Paper Mill	Black liquor odour and woody odour.
May 22	11	11:40-12:04	G	16	00-10	WSW	Paper Mill	Woody odour and occasional black liquor odour.
May 25	12	12:32-13:23	H	18	05-15	ESE	Paper Mill	Intermittent odour.
May 25	13	13:35-14:17	H	18	05-20	E	Paper Mill	Odour present.
May 25	14	16:39-17:22	I	16	00-15	NE	Paper Mill	Odour present.
May 25	15	17:29-17:55	I	15	05-15	NNE	Paper Mill Wood Treat.	Intermittent odour.
May 26	16	14:52-15:14	J	18	00-15	ESE	Paper Mill	Intermittent odour. Light rain.

Notes: 1. See Map 1 for sampling locations.
2. Met Conditions at 10 metres: AT=ambient temperature (°C); WS=range of wind speeds (km/hr); WD=predominant wind direction.

Table 2
Trenton (Domtar) Survey 1987
Mobile TAGA Odours `Fingerprints'
Target Source: Domtar's Wood Preserving Plant

Compounds Detected[1]	Estimated Concentrations (ug/m³)[3]							
Fingerprint[2] #=	01	02	04	05	06	07	08	09
phenol	03	150	50	100	10	20	15	15
methyl phenol	nd	25	05	20	nd	nd	nd	02
dimethyl phenol	nd	05	10	05	nd	nd	nd	nd
pyridine	01	03	15	15	03	03	05	10
picoline	01	05	10	10	05	01	04	10
methyl picoline	nd	05	02	03	nd	nd	01	01
quinoline	nd	25	20	15	01	nd	02	02
methyl quinoline	nd	05	05	02	nd	nd	nd	nd
naphthalene	05	90	150	150	nd	35	10	05
methyl naphthalene	05	75	90	25	nd	10	nd	nd
dimethyl naphthalene	nd	40	20	10	nd	10	nd	nd
trimethyl naphthalene	nd	15	15	nd	nd	nd	nd	nd
propanol	nd	nd	03	05	nd	02	05	02
styrene	nd	nd	05	02	nd	nd	nd	nd
C_8H_{10} (eg. xylenes)	nd	nd	nd	10	nd	nd	nd	nd
C_9H_8 (eg. indene)	nd	nd	nd	15	nd	nd	nd	nd
C_9H_{12} (eg. propyl benzene)	nd	nd	nd	10	nd	nd	nd	nd
$C_{10}H_{14}$ (eg. butyl benzene)	nd	nd	nd	10	nd	nd	nd	nd
$C_{12}H_{10}$ (eg. biphenyl)	nd	75	60	10	nd	05	nd	nd
$C_{13}H_{10}$ (eg. fluorene)	nd	10	15	nd	nd	nd	nd	nd
$C_{13}H_{12}$ (eg. methyl biphenyl)	nd	15	10	nd	nd	nd	nd	nd
$C_{14}H_{10}$ (eg. anthracene)	nd	10	10	nd	nd	nd	nd	nd
pentachlorophenol	nd	nd	nd	nd	nd	nd	nd	nd

Notes:
1. Tentative identities - based on interpretation of APCI/MS (TAGA 3000) mass spectral data.
2. See Table 1 for sampling locations and monitoring periods.
3. 2 minute averaged concentrations: estimated +/- 3X.

Table 3
Trenton (Domtar) Survey 1987
Mobile TAGA Odours `Fingerprint'
Target Source: Domtar Paper Mill

Compounds Detected[1]	Estimated Concentration (ug/m^3)[3]							
Fingerprint[2] #=	03	10	11	12	13	14	15	16
methanol	10	nd	nd	nd	nd	nd	nd	nd
ethanol	05	nd	nd	nd	nd	nd	nd	nd
pyridine	02	nd	01	nd	nd	nd	nd	01
naphthalene	15	nd	nd	nd	nd	nd	nd	03
methyl naphthalene	10	nd	nd	nd	nd	nd	nd	nd
phenol	25	02	10	01	nd	05	nd	nd
methyl phenol	02	nd	nd	nd	nd	nd	nd	nd
picoline	01	nd	nd	nd	nd	nd	nd	01

Notes:
1. Tentative identities - based on interpretation of APCI/MS (TAGA 3000) mass spectral data.
2. See Table 1 for sampling locations and monitoring periods.
3. 2 minute averaged concentrations: estimated +/-3X.

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